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PAPER ON SPITZBERGEN SEAS AND A BOAT JOURNEY IN LAPLAND.

BY ALEXANDER HUMBOLDT VAN DER HORCK.

It is with a feeling of the greatest pride and pleasure that I am called upon to deliver the first address on the question of polar exploration in a building which a geographical society calls its own.

All the more so because it is the American Geographical Society; for, my father having been an officer in the United States army, I had the rare fortune to have been born on American soil, and although I have spent many years of my life in Germany and England, still I always turn back to this country as the one to which I belong.

Familiar as I am with the prominent geographical institutions of England, Germany, France, Russia, etc., I have only to say, after having seen the work that has been done here, that this Society may compare favorably with the very best. Yes, more than this:

Nowhere have I seen such zeal and activity displayed in behalf of the interests of a society as in this one; and now that you have a house of your own, that the Society may call its home, now I think you have taken the first and greatest step toward securing its permanent establishment; and under the guidance of the learned and amiable president, Chief Justice Daly—whose illness does not permit him to be with us this evening—of whom Alexander Von Humboldt, in his letters to Bunsen, spoke in terms of the highest respect, and whose name is mentioned in Europe coupled only with expressions of the greatest esteem, together with the able management of its other officers, this Society has a future prosperity before it which can make it one of the first, if not the foremost, of its kind. It is a remarkable coincidence that the date of my own birth is the same as that of the incorporation of this Society.

Of what use is Arctic exploration? How can it benefit mankind? These questions have been put to me so often of late that it seems to me the Arctic explorer has first to answer them in presenting his subject to the public, a public which is growing more and more to view every question from an extreme practical standpoint.

From the disasters attending the Franklin expedition, from the thrilling descriptions of Kane, the idea has become prevalent that the attempt to enter those ice-bound regions is only connected with the greatest peril and sacrifice.

The world at large has formed a picture of a vast region covered with perpetual snow and ice, utterly barren, almost devoid of life, without vegetation, the awful stillness broken only by the terrible grinding of the rushing ice-masses as they come together with a startling noise, or of giant icebergs closing one upon the other, threatening the mariner with instant destruction; the long winter night covering the earth like a shroud, the short summer of perpetual daylight. What wonder that, with such a picture of desolation in the mind, the question arises: Of what interest to science or commerce can such a region be? The question of polar exploration, the question of Arctic discovery, for more than three centuries past, has been a commercial speculation, and the questions of science were either of secondary importance or entirely overlooked. Since, however, it has been proven that the discovery of a northwest passage is of little value to commerce and that the merchant has but little chance in those Arctic regions, with the exception of the pursuit of whales, seals and walruses; commerce has abandoned the field and science alone lays claim to this great Arctic land comprising more than 1,500,000 square miles. The expeditions sent out from Germany in the last few years have been more for the purpose of making scientific observations and collecting material in the different departments of natural history, until now nearly every year such an expedition is sent to the north.

In the winter of 1875 arrangements were made for a private exploration of the Spitzbergen seas. The expedition was proposed and intrusted to my care by Prof. Hartman, president of the African Society, and vice-president of the Geographical Society; Prof. Virchow, president of the Anthropological Society; and Prof. Reichert, director of the Royal Anatomical and Zootomical Museum, all of Berlin. My instructions were to make deep-sea dredgings and measurements determining the temperatures of the deep-sea climates and the oceanic currents, collecting zoological and other material; and completing these, to return overland and make anthropological investigations as regarded the inhabitants of these northern coasts. We left Hamburgh, by steamer, early in the summer, following the Norwegian coast, across the Arctic Circle, to Hammerfest, the most northerly town on the globe, where our

ship, chartered for the purpose, awaited us. We had, however, procured, *en route*, our final supplies at Bergen, that neat little town, warmed by the Gulf Stream, whose fjord juts into the North Sea. The wild and beautiful scenery of that jagged Norwegian coast, with its bold, rocky outline, impressed us deeply; but I will not detain you with a description, but take you at once on board ship, a tight, well-built schooner, fitted especially for Arctic service, with a Norwegian captain (an experienced old seal hunter), his mate and eight stout seamen as crew, besides my assistants and a photographer. We had all necessary instruments and equipments for our work, such as dredges, deep-sea thermometers with patent iron cylinders, hydrometers, microscopes, instruments for taking astronomical observations, *et cetera*. Keeping close to the coast, we held our course toward North Cape. Although the sun shone warmly, the black, rocky hillsides were covered with patches of snow. Towards midnight we came in sight of the high promontory, and dropped our anchor not a cable's length from North Cape. The beautiful weather—the perfect calm of the sea, stretching away toward the north a limitless waste of water—the stern, majestic rock, rising 1,000 feet perpendicularly out of the sea—the rays of the midnight sun (if we may so speak of a sun that did not set) falling in softened splendor directly upon the headland—the transparent purity of the atmosphere, all blended into a scene too beautiful to describe. The remarkable clearness of the atmosphere during these northern summers makes distance so deceptive that the far-off mountains seem to nestle closer, and one dare not trust to the eye in computing distances.

The Sea of Spitzbergen is a large shallow water, from 100 to 600 fathoms deep, extending between Spitzbergen and Nova Zembla.

This basin is of great interest, as the Gulf Stream fills it with its warm waters. The Gulf Stream, after twice encountering the polar current—once east of Newfoundland and once east of Iceland—has its waters cooled more and more until it reaches a temperature of 4.1° Celsius, or about $39\frac{1}{2}^{\circ}$ Fahrenheit, and being at their maximum of density at this temperature the waters of the Gulf Stream sink below the polar current, which it strikes off Spitzbergen and to both sides of Bear island in June and July; further south, however, when the atmosphere is colder.

Now we find its course more complicated, for as the temperature changes it rises or sinks; and we find the warm and cold currents arranged one above the other, or flowing side by side.

The warm body of water filling the Sea of Spitzbergen seems to extend to the north-east in the shape of a wedge, the base of which lies between Bear island and the coast of Lapland.

The surface temperatures vary from 50° Fahrenheit off the north coast of Europe, in north latitude 70° , to 36.5° Fahrenheit in north latitude 76° and 77° , during the months of June and July.

We found the line of demarcation between the Gulf Stream and the polar currents distinctly visible. The waters of the former are clear and have a blue color, whilst those of the polar current have a dirty green appearance which is owing, in a great measure, to the multitude of microscopic organisms and decomposed matter contained.

What a wonderful influence upon the climate of this region has this warm current which, after crossing over 5,000 miles of the Atlantic washes the shores of northern Europe!

I well remember landing on the Island of Tromsø, in 70° north latitude, on a parallel with the central belt of Greenland, and how I was struck on finding the hillsides covered with beautiful trees and flower gardens. While here I made an excursion up into the hills across the narrow channel to hunt up some herds of reindeer. My way led me through a beautiful valley which was walled in on either side by high perpendicular cliffs, behind which lay the reservoirs of snow and ice which poured their melted waters into the valley over high rocky ledges, these forming lovely cascades, and then rushing on to the sea in small streams that intersected the valley.

The ground was covered with bright green grasses and ferns, while flowers, such as the blue forget-me-nots and the purple geranium, dotted the earth, and patches of white reindeer moss hid the naked rocks here and there.

The balmy air reminded me of the perpetual spring that is said to exist on the high plateaus of the Andes.

Although it was near ten o'clock at night, the sun was shining warmly, and coming to a shady grove of ash and birch trees, some of which were from thirty to forty feet high, I threw myself on the ground with my coat off and took out my journal to make a few sketches—reflecting upon what a remarkable world of ours this is—when my reverie was interrupted by a faint musical sound, and suddenly I found myself attacked by a swarm of mosquitoes, which soon became so troublesome that I had to leave. It is mostly on account of the insects infesting the valleys in summer that the Lapps leave their winter quarters, and with their large herds of

reindeer wander up into the mountains and high plateaus bordering on the coast.

A little north of Tromsøe is the valley of Alten—the paradise of Lapland, as it is called—where the Norwegians, who settle here on account of the fisheries, sometimes raise small crops of barley, potatoes and garden vegetables during the short polar summer.

But we have gone back on our way. From North Cape our ship took a N. E. course, it being our intention to beat about in the Spitzbergen seas off the coast of Nova Zembla. Life on board ship was very pleasant, although we had but little spare time, our observations and dredgings being continued day and night—that is, literally speaking, there was no night, as the sun, during the brief summer solstice, is constantly above the horizon. The greatest harmony prevailed throughout.

A little undesirable variety was the insubordination of our crew at one time, under the inspiring influence of too much whisky, which had been taken from the lockers without the formality of asking permission. A superabundance of spirits was the consequence, but subjugation soon followed. The Norwegian sailor, like all other nautical natures, has a peculiar fondness for “strong drink.” The health of all on board was excellent, the men being accustomed to the Arctic seas.

We often came in contact with drift-ice, but our ship sustained no material injuries. Finally we struck the large field of pack-ice.

I well recall the clear, bright morning when the lookout first called “ice-blink to the north’ard,” and a scene of surpassing beauty met us, as we drifted nearer. One great, unbroken field of ice, as far as the eye could reach, lay glancing and glittering under the morning sunbeams; here and there were high hummocks, or ridges, irregularly piled upon the surface, where the ice-floes had been jammed together, all sparkling and reflecting the rays of a cloudless summer day. We sailed along the edge of the pack many days, sometimes shut in between the detached masses, but nowhere able to make a passage through the field.

Numbers of seals lay on the edges of the ice, sunning themselves, and tempting us to lower our boats and make an excursion in their behalf. They appeared but little disturbed by our presence and nearer approach.

Nothing, however, can be more exciting than a walrus hunt. Generally it is best to attack them when they are lying on the heavy ice, for on thin ice or in the water it is much more dangerous. They

can shiver ice from four to six inches in thickness when they rise from below and strike it underneath with their heads. I remember on one occasion crossing a field of new ice, with several of the men, when suddenly a herd of walruses appeared swimming beneath the thin ice, apparently following us, coming up underneath and striking the ice with their huge heads, shivering it into pieces on all sides of us, while we scampered for our lives toward the main pack, luckily near by, barely escaping these monsters.

I will not detain you with a tedious description of our cruise in the seas. Our operations were very successful, yielding us valuable results; and the greater part of the material gathered during the voyage is now in the museums of Berlin, where it is being arranged and determined. As regards our general observations, we found the bottom in the lesser depths, from fifty to two hundred fathoms, to consist mostly of sand and gravel; in greater depths, such as 500 or 600 fathoms, there seemed to be more mud bottom. We found in this numbers of small shells: some varieties of the mollusca, multitudes of the calcareous and arenaceous shells of the more minute organisms, the most predominant of which were those of the foraminifera and radiolaria. The submarine vegetation is much more meagre than might be expected.

Toward the beginning of August a change in the weather, heralded by cold stormy winds, then by heavy fogs, drove our little schooner under pressure of a heavy gale to the south-east. When the weather cleared we sighted land, which, according to our reckoning, must have been in the vicinity of Cape Britwin on the south-west coast of Nowaya Semlya. The weather continuing thick, murky and unfavorable to our further operations, we steered southward, until we entered Porsanger fjord. The stormy weather having by this time subsided, we sailed along the coast, and anchored off Swerholtklubben, an immense rock affording one of the greatest resting places for sea birds in the northern hemisphere.

This huge headland rises out of the sea like a perpendicular wall, traversed by numerous jutting, parallel shelves, where the rock has crumbled away and left ranges of convenient breeding places for the numerous sea birds resorting to the coast in summer. At early dawn, as our ship rode at anchor scarcely 300 fathoms from the cliff, we could see that it was literally covered with birds, packed side by side in countless numbers, every niche occupied. On the lower shelves and rocky ridges were to be seen large numbers of the eider duck, and the teiste (*Cephus mandtii*). On the higher ledges, and near

the top, were to be found many varieties of the gull, also the Norwegian lumme (*Uria bruennichii*). Wishing to see them on the wing, we had the sailors fire the small ship's-cannon, and the loud report startled the whole feathered tribe from their slumbers. They rose in one dense mass, like a cloud, the flapping of their wings reminding one of the report of musketry. As they passed over our heads in myriads, they seemed to darken the very heavens, and the noise of their flight was startling. Yet, upon looking toward the rock, there appeared to be just as many there; the number was not perceptibly diminished.

We wished to obtain specimens—a difficult and perilous undertaking—as it was necessary to lower a man over the sharp ledge by means of a rope tied around the waist, the chafing of which against the jutting ridges made it liable to break at any moment, and precipitate him into the waters far beneath. We lowered our boats, however, and pulled toward the land, seeking a place of ascent.

Finally a deep ravinewas discovered, which led up the acclivity, and we clambered with considerable difficulty to the top.* The outlook was impressive. The sun was just rising, the first time for many a long day that we had seen it thus, for the short polar summer was near its close. The bright ruddy glow of the morning was touching the whitened cliffs, whose rude slopes were covered with wild grasses, moss and lichens. The sea rolled calmly in front of us, whilst behind us lay a stretch of level land, the monotony of whose surface was unrelieved by tree or shrub. I now directed my attention to excursions in the interior for an anthropological investigation of the inhabitants. To this end I fitted out with supplies a smaller and more suitable boat, and took with me seven sturdy oarsmen and a quantity of plaster of Paris in well-sealed tin cases, with which I proposed taking casts of living Laplanders. My plan was to enter the deeply indented bays that stretched into the interior, until we came to the mouth of the numerous small rivers. Here we unloaded, packed our goods in bundles, secured porters, and started overland. Our porters were the so-called *Sjö* Lapps, or “Sea” Lapps, a set of broad-shouldered, bow-legged fellows, diminutive in stature, who are to be found along the shores of the lakes and streams in summer fishing. They were well adapted to carrying loads; each usually taking about forty pounds, which, owing to the swampy nature of the ground, was a sufficient weight. The bundles were

* The formation of the rocks of this coast is mostly granite, gneiss, and mica schist.

fastened to their backs by coverings of reindeer skin, which met and were securely fastened across the breast, thus protecting the goods from the weather. Thus equipped we marched Indian file along the marshy banks of the rivers. The country abounded in game, the rivers teemed with salmon and trout, whilst water-fowl of every species were in great plenty. Sometimes the scenery was exceedingly charming. The streams of North Lapland are interspersed with waterfalls and rapids, one falling into the other, and thus rendering navigation at many places almost impossible. The entire region is undulating, but barren and desolate, covered with short stunted grass or fields of reindeer moss, or interminable swamps intersected with lakes, having the character of the Siberian tundras. Deep valleys marked the water-courses of the numerous creeks and rivers creeping between the hills. The soft spongy ground yielded at every step and made our marches extremely tiresome, especially as the only change was to hard, rough and stony ground. Traversing the hills in this way through the day we would usually return at nightfall to the river-bank to make our encampments. Here the banks were dotted with little groups of stunted trees, such as the dwarf-birch, etc.

By these incursions we gained much information concerning the wandering tribes of Lapland. These people call themselves, in their own language, *Saame*, and are divided into two classes, the Nomadic or Mountain Lapps, and the Sea Lapps, the former wandering about in isolated families over the high plateaus during the summer with their large herds of reindeer, whilst in the severe winter they retreat to the fir-woods where their herds may find moss while the country is covered with snow and ice. These herds of reindeer sometimes number several thousand head. At one time, when the warm south-west wind caused large numbers of the animals to wander toward the coast, I had the rare fortune of seeing a herd numbering nearly 8,000. As far as the eye could reach the naked hills were covered with them, some with perfectly white skins, whilst others of dark color gave a beautifully checkered appearance to the whole, and the huge antlers towering above their heads seemed like a forest of leafless branches. The Lapps who were present showed us how they used the lasso, in the throwing of which they are very expert. The study of the Laplandic tribes has become of the greatest interest to anthropologists. Their physical characteristics are very peculiar. They are an exceedingly small race. The head is broad (brachycephalic) but low from base to crown, so that the face

has a broad compressed appearance. The eyes are usually small and irregularly shaped, slanting downward at the outer corners. The nose is broad and flat, the mouth large, the ears small and well shaped. The hair is smooth and straight, but of scanty growth. The upper portion of the body is large and well proportioned, arms long; the legs, however, are short and disproportionate, usually bowed, with the knees standing far apart. Their food is the flesh of reindeer, wild beasts, fish, and the berries growing in the extensive swamps. They are also very fond of fat, grease and oil, and come down to the whale fisheries on the coast to gather pieces of fat, blubber and meat, standing eagerly around and watching their chance to secure the morsels, even eating them raw. In taking plaster casts of the face I was compelled to rub the skin with olive oil, and always found it very difficult to restrain them from licking it away, at least as far as they could reach it with their tongue. To prevent this I afterwards applied stinking train oil, but with no greater success.

The Lapps live mostly in tents of poles, over which skins are laid. The costume of this people consists, first, of a curious head-dress, the men wearing high, broad-banded caps, the top of which resembles a thick cushion about a foot square. The women, on the other hand, wear a cap into which a large carved piece of wood is inserted, giving the whole appearance of an ancient helmet. They also wear a large *peske*, or fur coat, generally of reindeer skin, the leggings and long-pointed shoes being made of the same. As they have no pockets it is curious to see the manner in which they stow away everything inside their coats. They fasten them around the waist by a broad belt and make a forage-bag of the upper story stuffing into it articles of clothing, shoes, eatables, the fine grass with which they cover their feet, whisky bottles and other things not to be mentioned until the coat bulges out like a huge sack, causing the individual to appear extremely funny with his short crooked legs looking as though they had been stuck through a barrel. The belt, which is of reindeer or bear skin, is richly ornamented with brass talismans, mystic charms, and the teeth and claws of the bear, wolf, glutton, etc. The Sea Lapps subsist mainly by fishing or gathering birds' eggs from the great breeding places on the coast, and present the same physical type as the mountaineers where intermarriage with other races has not taken place. I was fortunate in securing large and valuable collections from heathen graves and a number of plaster casts of living Lapps, the only specimens of the kind in existence.

The difficulties I had in securing these impressions as well as anthropological measurements were great, for I had to overcome their superstitious fears, which were thoroughly aroused, even when I took measurements with the craniometer. The impressions of the face were secured with the least difficulty. After oiling the skin I covered the features with a thick coating of plaster which, after it had set, usually came off easily. However I was not always so fortunate for upon one occasion meeting an old Field Lapp (Nomad), a splendid type of his race, I desired very much to take his face. After great persuasion he yielded on condition that I should not cut off his beard. I therefore stuck the stiff, bristly hairs together with flour paste as well as I could, and after generously oiling him covered his face with the gypsum. After it had hardened I attempted to remove it when, to my horror, I found that it adhered firmly and I was compelled to take a scalpel and with the utmost care slowly separate the hairs, during which painful operation the Lapp, although lying on his back, struck out with hands and feet; his mouth being closed he made the most unearthly noises through his nose. My men, who were mostly Lapps, stood about in great excitement as they witnessed his agony, and I myself was covered with perspiration. The temptation was great to leave the Lapp to himself to get it off as best he could, but I succeeded finally in securing the form but with it came the greater part of the old man's whiskers. I had scarcely freed him and washed the blood from his face when he sprang forward and furiously grasped my loaded gun which I took from him with difficulty and succeeded in bringing him to terms. In taking casts of the ear I usually closed the auditory orifice with a piece of cotton, oiling the skin and covering the whole with plaster, which, when dry, I carefully pulled off, the ear yielding. The operation of "having your ear pulled" is rather painful under such circumstances, and the Lapps were never anxious to let me have the cast of more than one ear!

Skulls can only be taken from the graves with the greatest secrecy as they watch over the burial places with superstitious care. These ancient burials are usually at the hallowed groves, near which they were accustomed to assemble for worship, and they are still designated by the remains of stone pillars or by the native name attached to them, such as "Pattsam dudder" (holy mountain), or "Patts jokki (holy river). The tumuli are found on the edges of the cliffs bordering on the sea, on the side of the mountains, or the steep shores of the lakes or the rivers, and are generally of three different

forms. The dead are often found wrapped in thick layers of birch bark which have been sewed together with sinews of animals. These coverings are frequently richly ornamented with curious drawings of men and animals, and rude pictures of the former life of the heathen inhabitants.

Toward September I began to make preparations for returning overland, taking a route which has hitherto escaped description. My plan was to proceed from Vadsö to the Patts jokki (holy river), thence across the Lake of Enara (the largest of the Lapland lakes) to the River Ivallo, which we were to ascend; then crossing the mountains forming the water-shed, follow down the River Kitinin to the Gulf of Bothnia, passing through Norwegian, Russian and Finnish Lapland. The greater part of this journey was to be in boats.

Vadsö, our starting point, is the site of the north-coast whale fisheries, and lies $70^{\circ} 16' N.$ L., and $30^{\circ} E.$ L. The fisheries are very extensive, and carried on in an original manner. Extensive buildings have been erected on a small island in the Veranger bay. With two steamers, fitted for the purpose, they pursue the swift and dangerous "finned whales" (*Balænoptera rostrata*), which sometimes reach a length of 100 feet. In the bow of each steamer is a cannon, swinging upon an immense steel pivot, from which a curiously shaped harpoon is fired, to which is attached by a chain a long rope. The steamers go along the coast, and as soon as they catch sight of the game start in pursuit, and, when near enough, discharge the harpoon, which sometimes has an explosive shell attached to it. If the animal is not immediately killed, the ship is pulled through the water at a furious rate, until loss of blood makes the huge creature succumb. Sometimes, however, the vessels are dragged about for hours.

All being in readiness for departure, we left Vadsö. Our outfit consisted of instruments, furs and preserved fruits, meats and vegetables, with several cases of liquors and wines, as well as boxes of ammunition and guns, for the country through which we were to pass abounded in game. Some of the larger animals of this region are the wild reindeer, the fox, wolf, bear and glutton, which latter is much dreaded by the Lapps, as it destroys great numbers of their reindeer yearly. The glutton is about the size of a small bear, and perching himself upon the branch of a tree overhanging a deer-trail, lies in wait. As the reindeer come along—as when they go to water—and pass underneath the branch, he suddenly pounces on

some unwary buck, and fastening his sharp teeth in the neck of the animal, drinks its life-blood until it is killed, the other reindeer fleeing with fear. I had sent to the south with the ship all the material we had previously gathered. Leaving the island, we crossed the bay and entered the mouth of the Patts Jokki. We had before us a broad, majestic stream, with high rocky banks, which is the outlet of Lake Enara, its length scarce fifty miles, but in that short distance it has a fall of 400 or 500 feet. In fact, it seems to be but a chain or succession of larger and smaller lakes, connected by waterfalls and rapids, there being no less than eight of the former and twenty-seven of the latter. These present almost insurmountable difficulties for navigation, and sometimes portages of a mile or more in length would have to be made, in which we were compelled to drag our boats over felled trees, or clear a way through the brush. At other times we had to pole up the rapids, so that our progress was slow, and the men, discouraged by the hard work, were only prevented from deserting us by the promise of additional pay and presents if they would hold out to the end of the journey. At the foot of the first waterfall there was a Russian missionary chapel, and around it clustered the huts of the Skolter Lapps. Its cupolas were painted a bright green, which added to the picturesque beauty of the scenery. The second waterfall—Karakoski—was still more impressive, for directly over it projected a high, smooth rock, from which we had a magnificent view of the surrounding country. The waters of Hvalojas jaure (or lake) rushed between two high black boulders in one unbroken volume, as if through a huge stone gateway, and fell into a great circular basin some twenty feet below, causing the spray to ascend far above our heads, then disappeared in a foaming rapid behind a bend in the river. The heights, on both banks, were covered with fir and dwarf-birch trees—the placid waters of the lake stretched away in the distance; over its glassy surface the waterfowl were skimming, whilst away to the south-east we could see a range of blue hills—Piattsam dudder, the “holy mountains” of the natives. The river abounded in salmon, and one had only to drop a line into the swift current below the falls to soon land a fine large fish. The formations in the high rocky banks were very interesting; sometimes great granite boulders were piled together in huge heaps, giving evidence of the giant forces which at some earlier period must have been at work. Starting at early dawn, we journeyed through the day, making our meals at the portages which were without number. Scarcely would we pass one waterfall before we would hear

the roar of the second, and it seemed that we never should succeed in ascending the river. At night we selected a suitable camping place, spreading our furs on the dry ground before a large fire. The nights were intensely cold, the thermometer falling below freezing point; in fact this entire region is, according to the latest meteorological observations, the European centre of cold. Often I would awake in the middle of the night to find my wet clothes, which, on account of the loss of a part of our baggage in the rapids, I was unable to change, frozen stiff to my body, even while lying near the fire. As our tent clothes had also been lost, and our furs, we had to sleep under the open sky, on a few reindeer skins spread over some fir branches for a bed. However, we kept in good health and spirits. We had ample opportunities for seeing the wonderful aurora borealis, flashing brilliantly over the heavens.

On one occasion we had a rather curious adventure. While crossing a lacustrine part of the river called Kjoalme jaure in the early part of the night, we were suddenly surrounded by swarms of lemmings (*Myodes torquatus*), an animal like the mountain rat. They swam round the boat and attempted to clamber into it, so that it was with the greatest difficulty we could keep the fierce little creatures from boarding us by beating about with the oars, at which they would set up sharp shrill screams similar to those of the musk-rat. After some time we succeeded in passing them. These little animals come unexpectedly down from the mountains, no one knowing exactly whence, and appear in millions, swarming over the whole country, eating up almost everything that comes in their way. Neither rivers nor lakes seem to deter them, both of which they swim with ease, usually keeping on their destructive path until reaching the open sea, which they vainly attempt to cross, never swerving from the direction once taken until they sink exhausted beneath the waves. Thus perish countless numbers. They commit great ravages, and are as dreaded in the north as the locusts are in Egypt. Years, however, elapse before their reappearance, or until they suddenly descend from their rocky retreats. The Lapps tell us that they rain from the sky; many of them stating that they have actually seen them fall. This idea may be owing to the fact that the lemmings are frequently seized by birds of prey, but the fierce little creatures extricate themselves, the bird loosening his grasp, and thus the prey, to all appearance, drops from the clouds. Their fur is of a red or yellowish-brown color with black spots on the back and the breast white.

Ascending the rapids we lost some of our baggage. At Menikas jaure we came to a village of Russian Lapps, consisting of a few miserable huts and peculiar little houses built upon piles about three or four feet above the ground, most likely store-houses, thus constructed to keep their contents from being destroyed by animals such as the lemming. From this place another boat, manned by Russian Lapps accompanied us, as the part of the journey just before us was both difficult and dangerous. Arriving at the place where the boundary lines between Norwegian, Finnish and Russian Lapland meet, I climbed to the top of a hill 450 feet high, from which I had quite an extensive view of the surrounding country. The land beyond the river was naked and desolate-looking as far as the eye could reach, but the valley of the river itself was thickly wooded with fir-trees, the ground covered with reindeer moss. Far below one could hear the faint voice of the waterfalls, or here and there catch a glimpse of the white foam glittering between the trees. Nothing can be cleaner or tidier looking than the beautiful reindeer moss, stretching like a snowy white carpet between the dark pine trees. We crossed the sixty-ninth parallel north latitude, and, after innumerable difficulties, reached Lake Enara, a large sheet of water, triangular in shape, the greatest length of which, from north to south, is about sixty miles; its greatest breadth, from the Patts jokki to the opposite shore, is nearly forty miles. This lake has a great number of affluents, the largest of which are Kamas jokki and Ivallo. The latter we were to ascend. Lake Enara is dotted with innumerable small rocky islands (the largest being about three miles long); some are barren, others covered with trees and moss.

Our men having by this time become unmanageable, we landed on a small island, and unpacked the boats. To avoid wearying you with the troubles that followed, I will only say that the men deserted us during the night, taking the boats with them, and only by the aid of some Fish Lapps, whom we hailed, were we enabled to proceed to the mouth of the Ivallo. Arriving at this place, we found a number of pearl-fishers, from the River Lutto, who offered us, for trifling sums, rare pearls, of a beautiful color, some having the highly valued rose color, which they obtain by diving, and bring the shells out of the cold streams of Russian Lapland. After procuring men, we continued our ascent of the river, with but slow progress. As the days were growing shorter we attempted to force our journey by pushing forward during a part of the night, using torches. We

could also, thus, see to spear the salmon with which the stream abounded.

One can scarcely conceive anything more novel or exciting than poling up these rapids after nightfall. The ascent was sufficiently difficult and dangerous by day. In the bow of the boat a large pine torch threw sufficient light for us to see the way as we shot into the swift current. The foaming waters dashed between the sharp black rocks with a roaring noise. The men stood erect, pushing with long poles, calling to each other with shrill, incessant cries, above the din of the rapids. At intervals the waves would rush into the boat wetting us thoroughly as we sat amid the weird, wonderful scene, watching the red glare and curling smoke of the torch or the pictures of wild beauty it revealed to us out of the darkness. The Ivallo is a swift mountain stream, flowing impetuously through a deep gulch or canon between high mountainous banks, and filled with rapids, making its surroundings wild and picturesque beyond description. Something remarkable were the reflections in the water in those parts of the river that were tranquil and deep set. One could scarcely determine or detect the water's edge, the white pebble-stones in the picture being just as distinct as on land, the limpid, unruffled waters scarce discernible as they held the reflected image. I never saw this equaled, and I think it was partly owing to the perfect quiet of the water, and partly occasioned by the transparent purity of the atmosphere. The frequency of mirages in the polar seas also struck me. I recall once seeing a rocky island that lay off the north coast, raised high in the air, seemingly enveloped in a silvery cloud.

At the new gold mines in Kultala, we secured porters, and immediately prepared for our journey over the mountains. These mines (which were first opened in '71) are in full operation, and seem to be yielding richly. They are in the hands of the Finnish government, work being carried on only during the two warmest months of the year. I saw many bags full of bright yellow nuggets, some of which were very large. The whole place has the character of a busy mining camp—the long runs; the cradle on the river bank; the men with their picks; and everywhere the large stone heaps that had been dug up while in search of the precious metal. We now ascended the steep river-bank, which is between 800 and 1,000 feet high. Upon reaching the top we found ourselves on a high plateau—the watershed which casts the waters to the Arctic ocean and the White sea on one side, and to the Gulf of Bothnia on the other. This range of

high land was covered with small pine or fir trees ; countless springs issued from the earth ; large swamps extended over the whole region, ever intersected by small creeks and rivulets. We followed the course of the Kivi jokki, a small branch of the Ivallo. When about half way across the plateau we came to a lake called Wavololampi, lying on the highest part of the mountain ridge. It was a very peculiar reservoir—about three miles long and one and one-half miles wide—for the waters were flowing from it both ways ; that is, to the north, through Kivi jokki, into the Ivallo, thus connecting with the Arctic ocean ; and on the other side the Wavollo oya flowing out of the lake into the Kitinin, forming a water-link of communication between the Polar sea and the Gulf of Bothnia. On one side of this lake lies a large swamp, through which the Kivi jokki receives its supplies ; but during the dry season this communication ceases, and a dry ridge of land separates the waters flowing to the north. Thus it may be said that the Scandinavian peninsula is an island during a part of the year. We camped on the border of this remarkable lake for the purpose of taking observations and making sketches. Nothing could surpass the natural beauty of the place, whilst the abundance of game of delicious flavor enhanced the pleasure of scenery. We now descended the Kitinin river to the Gulf of Bothnia, and crossed to Uleaborg, where we were cordially welcomed by the governor of Northern Finland, and at whose residence I remained some time to recover from the many hardships, and then took my way across the great continuous lake system of Finland, reaching St. Petersburg, and from there returned to Helsingfors, the capital of Finland ; then onward to Sweden and Norway, returning to Berlin in the beginning of last winter.

Before closing my lecture, allow me to make a few remarks in defence of polar explorations. I have read with interest the ably written articles by Dr. Hayes, who, as you all know, ranks among the foremost of Arctic explorers. Many may think his expressions were too forcible ; but I can only say that it proves that the doctor spoke his open, honest conviction, like one who is with the matter heart and soul. And who will escape a keen sense of disappointment when an expedition so splendidly fitted out meets with such adverse circumstances as the best of us cannot control.

Picking up a newspaper a few days since, I read the following : “ The subject of polar exploration was never more in disfavor than now. The return of the Alert and Discovery has conclusively shown

how little of interest there is in those far-off regions to warrant such vast expenditure."

But this is a fallacy in popular opinion. To those who have searched more deeply into these questions, to those who have entered the "pass" and stood on the threshold of its mysteries, quite a different view is presented. Every step finds us surrounded with objects of interest. We see the workings of nature, of whose grand forces we have scarce a solution. A new era in the history of our globe will dawn when the revelations of knowledge hidden within the vast area of this yet undiscovered region, are brought to light—for the relation which this region bears to the position of the axis of the terrestrial spheroid, and its peculiar character, give opportunities for observing many phenomena under singular relations; while the conditions of the earth's surface, and the valuable field of research for the geologist, are to be considered. In fact, it is but reasonable that we should expect rich and unforeseen discoveries in science, of which as yet we have no conception. The first great advantage to commerce in the early history of arctic exploration resulted from discoveries by Henry Hudson—that brave, intrepid sailor; it was the establishing of the whale fisheries, one of the most extensive trades that has ever flourished, in which large fleets, of almost all nationalities, were yearly engaged, and even now the Dutch are organizing a new expedition to search for new grounds. Immense have been the revenues collected from this; close upon this followed the profitable pursuit of the hunters of seals and sea-horses. A Siberian explorer named Liaghoff, by observing a herd of reindeer coming from the north over the ice, was induced to seek land in that direction, and travelled with sledges across the ice, until he came upon three large islands, since known as New Siberia, the largest of which, called Kotelnoi, lying in 76° N. L., is 100 miles long by sixty miles broad. Here Liaghoff found immense alluvial deposits of remains of animals, fossil bones, wood, etc., not unlike those found along the whole arctic coast of Siberia. He obtained from the government the exclusive right of digging for the bones of the mammoth. The deposits were so great that in one year no less than 20,000 pounds of fossil ivory were gathered. To what reflections do these remains of ages gone by lead us! Here that huge and wonderful animal, the mammoth, must once have ranged in perfect freedom over these now trackless wastes of ice and snow. The very wood tells of by-gone vegetation now extinct.

From these islands Hedenström, Anjou and other Russian explor-

ers thought they discovered an open sea to the northward, the so-called Polynia, about which there have been the wildest speculations. Wrangell, too, in his explorations, saw dense vapors rise in that direction, and finding the winds blew from there freighted with moisture thought it a still further evidence. Many examples of this kind might be quoted, the expedition of Nordenksjöld, in the last year, apparently opening a way by which the riches of Siberia and the products of the fertile countries marked by the water-courses of the Yenisei and Obe may find their way to European waters.

Then there is the finding of valuable minerals in these northern latitudes—the gold mines in Lapland, discovery of cryolite in Greenland as well as meteoric iron extending a distance of nearly 200 miles. Are we not already ready to advance farther into this vast realm of marvelous interest? But let us turn now to science and see whether it may be profitably enriched by arctic explorations. We know that the Arctic ocean teems with life, and in disclosing the more minutely organized animal life by means of dredging machines we find an important chain in the economy of organic nature. Of the larger inhabitants of this sea, the whale, and the numerous varieties of fish, very little is as yet known, either of their movements or the relations they bear to one another, or the condition under which they live, or their migrations and distribution as regards geographical area and oceanic currents. It is conjectured that the whales journey to the far north, during a part of the year, where they must find open water. The presence of the walrus is also a sure indication of the existence of submarine vegetation. The migration of certain birds northward is suggestive; passing in their summer flight over those barren tracks across southern Greenland they must necessarily find food in the far north, which leads to the inference that beyond the zone already explored some more genial clime must exist. Here, too, is the habitat of such terrestrial animals as the fox, bear, reindeer and musk-ox. Thus, in a zoological point of view, questions of great interest arise. So it is in botany. There is a rare and peculiar vegetation in these northern regions of which we know as yet but little, and naturalists anxiously await further results as they may greatly help us in determining the geographical distribution of plants. In the science of anthropology we may look to important results in these arctic regions. The races inhabiting the extreme North are becoming objects of the highest interest, as to whether they are offshoots of certain races

living in the more temperate zones who have degenerated under climatic influences and the peculiar conditions under which they exist, and have thus become pathological, or whether their physical and psychological peculiarities are typical of a distant race or races.

How far may the past history of man be involved in bringing to light this subject? But little more than a third of that unknown region has been explored, yet amid its most barren solitudes the traces of former inhabitants are found, and although these are the remains of past ages they tell us of the wanderer of those by-gone periods and show us that man has once dwelt in these lonely wilds. He has been traced as far north as $81^{\circ} 30'$, and it is plausible to conjecture that he has existed still nearer the pole, although the English expedition found no remains beyond this latitude.

We pause, bewildered with the primeval panorama of "umbrageous grots and caves of cool recess;" we breathe the balmier air and over the lapse of centuries clasp hands with man and ask, Why this transformation of nature? and Why these icy sepulchres entombing the redundant foliage? The mysterious roving of these isolated tribes deprived of metal and wood, dependent, as they seem to have been, upon such materials as bone and stone for the construction of all utensils, implements and weapons, place them in close relation to the human being of the prehistoric age of stone. The geological results of polar exploration will be of the greatest value. There are the paleontological evidences of life underlying the glacial period, the organic remains discovered in the carboniferous and miocene rocks, each revealing facts of the highest importance to geology, giving evidence that in the far-off past there has existed a highly developed and exceedingly luxuriant vegetation. The relation which the miocene (middle tertiary period) flora bears to preceding and succeeding vegetations is a subject of weighty consideration, also the light it throws upon the physical condition of our planet in past geological epochs. When we reflect upon the probably forced migration of the Scandinavian flora, supposed to be one of the oldest, to Greenland and America, when we have positive evidence of the existence of ancient forests in a warmer period preceding the glacial, when we picture to ourselves those days of antiquity when the mammoth and other huge animals, long since extinct, stood in the shade of dense woodlands, where now vast wastes are bound in by the perpetual barriers of snow and ice, we marvel at the changes our earth has undergone. Great tracts of

land formerly above the ocean are now submerged ; could these be raised again above the water, this replacement of water by land would still be insufficient to account for the phenomena of to-day. It is asserted that these great revolutions afford evidences of changes in the angle which the earth's axis forms with the plane of its orbit, and that the ellipticity of the orbit itself has varied greatly.

In all branches of physics experiments near the pole are most desirable, because of the supreme or intense workings of nature's forces there. Opportunities for the spectrum analysis are here best and surest, because the sun is at low altitudes above the horizon ; only in such high latitudes can we separate the terrestrial from the solar lines in the solar spectrum. By the same means we may be able to discover the chemical elements involved in that mysterious and beautiful phenomenon, the northern lights. The observations by means of the pendulum, as made by Sir Edward Sabine, are of special value to geodesy or geodetic measurements ; but until we can make these at or near the Pole itself, so long must the results be incomplete and doubtful. The connection between geodetic and astronomical measurements with local gravity make it of the highest importance that the pendulum observations should be more complete ; for the assumption regarding the peculiar form of our earth—the supposition that the earth's surface, and each adjacent stratum of invariable density, are surfaces of revolution, and connected thus with the ellipticity of the earth—has by some been considered incorrect, and it is therefore very desirable that it should be verified through actual experiment still further north. While, in meteorology, a precise knowledge of the distribution of land and water within the pole areas is essential to understand how far the climatic and atmospheric conditions of the globe are affected by it, we have but to look at the valuable work done by the Swedes and Norwegians, who are now so active in northern explorations, and the meteorological charts of Professor Mohn, of Christiana. Laying aside all these questions of scientific significance, the simple desire to complete the geographical knowledge of our earth would be a sufficient incentive to enter upon this vast unknown. The very divinity within us impels us to trace in all directions the mystic footprints of nature.

Can you link together the hurried thoughts I have just given you, and not feel that our first question is answered, and that, practically, it is a great accession to human knowledge, and of such signifi-

cant value to mankind that it is a most laudable ambition to seek a pathway to the poles of the earth—in fact, a duty not to be lightly thrust from us? As to the difficulties to be encountered: in contradiction of all that may have been said and written, there is scarcely more of danger to beset the mariner in these polar seas than is common to all who “plough the changeful deep.” Nor should imaginary fears make us unreasonable, or difficulties weaken our purpose. The extreme healthiness of the arctic regions is a fact well established, and it has been observed that persons suffering with pulmonary or bronchial affections were exempt from them whilst in those latitudes. Official statistics have shown that, of almost all seas visited by government vessels, the polar waters have been the healthiest.

We would not think unkindly of those gloomy theorists who look only upon the dark side of the picture, but say to them, that with the experience gained by the many preceding failures, with the advanced methods for scientific investigations, with the service of good steamers properly provisioned, and especially by establishing permanent stations and supply depots, which may be surely and safely pushed northward, we need not apprehend insurmountable difficulties, nor think it impossible to penetrate solitudes that may never have been disclosed to the eye of mortal.

Mr. Jas. T. Gardner moved a vote of thanks to Dr. Van der Horck, and said: I would call the attention of the Society to the special significance of the interesting paper read before us this evening, as it indicates a profound change taking place in the character of arctic explorations. There, discovery of new shore lines and channels, formerly the leading object of voyagers, has already become of secondary importance to the investigation of those great natural laws which govern arctic life, arctic climate and arctic currents—laws most easily comprehended in those regions, where their workings are on a Titanic scale, though their effects are felt as certainly in our own atmosphere, and in those ocean currents of the Atlantic and Pacific whose temperature, strength and direction control the very distribution of life and development of civilization.

The vote of thanks to Dr. Van der Horck was then passed unanimously.